Advances in computational photography techniques for cultural, historic, and natural history materials

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Our talk presents advances in robust new imaging tools from the emerging science known as Computational Photography. The common feature of the computational photography imaging family is the purpose-driven, selective extraction of information from sequences of digital photographs. The information is extracted from the photographic sequences by computer algorithms. The extracted information is then integrated into new digital representations containing information not present in the original photographs, examined either alone or sequentially.

We will describe robust photography-based digital techniques for use with a wide range of cultural and natural history materials and associated research. We will show the use of these tools in a range of contexts including fine art conservation, research of museum and library collections, and documentation of rock art.

Examples of existing and cutting-edge uses of photography-based imaging will be presented, including Reflectance Transformation Imaging (RTI), Algorithmic Rendering (AR), camera calibration, and methods of image-based generation of textured 3D geometry.

The most mature and widely adopted technique for cultural heritage research is Reflectance Transformation Imaging. RTI creates digital representations from image sequences where light is projected from different directions. The lighting information from this image set is mathematically synthesized into an RTI image, enabling a user to interactively re-light and enhance the subject's surface in incredible detail. An Institute of Museum and Library Services (IMLS) sponsored training program is bringing a four day RTI training to all six masters programs in art conservation in North America, as well as four regional museum trainings open to museum professionals. As a result of this program over 150 museum professionals and pre-professionals will be fully trained in RTI technology, in addition to the many institutions that are adopting RTI outside of this program.

This talk will present the latest developments in RTI. We will examine multi-spectral RTI and the hidden topological landscapes disclosing under-painting and drawings in the infra-red and the fine surface information disclosed in ultra-violet wavelengths. We will discuss RTI of subjects under magnification using macro and microscopic optics as well as updates in viewing technology.

New developments in the related technology Algorithmic Rendering (AR), which uses the same data sets as RTI, will also be presented. The development of new AR technology by Princeton University and Cultural Heritage Imaging is supported by a significant grant from the National Science Foundation. The end-product will be an open source tool which will extract and merge visual information available only under certain lighting conditions, certain wavelengths, or certain imaging modalities. Cultural heritage professionals will be able to generate high quality, comprehensible illustrations for documentation, scientific study, and sharing with colleagues, collection visitors, and the public.

New software tools to better collect and manage the metadata surrounding the creation of RTI and AR will also be discussed. This "digital lab notebook" is a critical element in the generation of scientifically reliable digital representations that enable future reuse for novel purposes, assist the long-term digital preservation of the virtual representations, and aid the physical conservation of the digitally represented museum materials.

Computational photography is a rapidly expanding field generating new tools and methods that can aide conservators in the documentation, study, and widespread understanding of the art works under their care.

Presenter

Carla Schroer is co-founder and director of Cultural Heritage Imaging (CHI) a California non-profit corporation, incorporated in 2002. Carla leads the training programs at CHI, along with working on field capture projects with Reflectance Transformation Imaging and related computational photography techniques. Carla also directs the software development and testing activities at CHI. She spent 20 years in the commercial software industry, directing a wide range of software development projects including Sun Microsystems' Java technology, object oriented development tools, and desktop publishing software. She has extensive experience in software licensing and open source projects in both the commercial and non-profit sectors.